General Engineering Requirements

1.1 General Information

1.1.1 Application and Purpose of Criteria
1.1.2 Types of Projects Affected
1.1.3 Requirements

1.2 Engineering Report and Preliminary Plans

1.2.1 Goal
1.2.2 Purpose
1.2.3 Contents – General
1.2.4 Contents – Wastewater Collection Systems
1.2.5 Contents – Wastewater Treatment Plants
1.2.6 Submission of Engineering Report and Preliminary Plans

1.3 Plans and Specifications

1.3.1 General Content of Final Engineering Plans
1.3.2 Plans of Sewers
1.3.3 Plans of Wastewater Pumping Stations
1.3.4 Plans of Wastewater Treatment Plants
1.3.5 Specifications
1.3.6 Review and Approval Procedure
1.3.7 Revisions to Approved Plans
1.3.8 Construction Supervision
1.3.9 Operation during Construction
1.3.10 Final Inspection of Treatment Facilities
1.3.11 Reliability Classification
1.3.12 New Technology

Appendix 1-A Wastewater Discharge Checklist
Appendix 1-B Guiding Principles, Goals, and Implementation Methods

GENERAL ENGINEERING REQUIREMENTS

1.1 General Information for projects reviewed by the Division of Water Resources

1.1.1 Application and Purpose of Criteria

These design criteria apply to the development, design, and submission of engineering documents for projects that convey or treat wastewater in the State of Tennessee as listed in Section 1.1.2. The Division of Water Resources (Division) staff will use the design criteria for the review and approval of those projects. However, these criteria are not laws, rules, or regulations.

"The Tennessee Board of Water Quality, Oil and Gas has broad rulemaking authority such that it may adopt regulations necessary to advance the legislative policy of preserving and protecting the waters of the State from conditions of pollution . . ." (Attorney General Opinion)

The Division does not recommend promulgation of these criteria as regulations. It has successfully applied an approach of using design criteria for establishing the requirements for review of wastewater conveyance and treatment projects without using a formal regulatory process. The intention of this approach is to provide flexibility during the design and review process for inclusion of technical advances, new products, and innovative approaches based on sound engineering judgment. By definition, these criteria represent "standards by which a judgment can be made; a model, test, or measure."

The Division has observed many instances in municipalities across the state where leakage of water into wastewater collection systems (I/I – infiltration and inflow) has been a direct or indirect cause of permit violations and pollution of the environment. Additionally, I/I reduces the capacity of wastewater collection and treatment systems. In some cases, this loss of capacity has hindered growth and caused economic problems in those communities. Utility customers pay higher bills because I/I in wastewater collection systems increases the cost of conveyance and treatment.

Modern, proven technologies and materials are commonly available to stop or prevent leakage into wastewater collection systems. Therefore, these collection system design criteria promote new sewer designs that minimize the potential for infiltration and inflow. Examples would include methods that prevent trench water accumulation and stream capture, or new technologies such as HDPE heat fused pipe. Additionally, the design criteria include new design procedures to minimize solids deposition within sewers. The intention is to improve energy efficiency and system sustainability. Project reviews will ensure that life cycle analysis (including the cost of I/I over the life of the project) is part of design criteria and required for engineering report/plans submittal. Life-cycle cost analysis (LCCA) is an economic method of project evaluation in which considers all costs arising from building, operating and maintaining a project. LCCA is well suited to the economic evaluation of design alternatives that satisfy a required performance level but may have differing investment, operating, maintenance, or repair costs, and possibly different life spans. LCCA is particularly relevant to the evaluation of investments (high initial costs versus reduced future cost obligations). For example, one alternative may have a significantly higher initial capital expenditure, but have much lower operation and maintenance costs compared to another alternative. Over the life of the project, the alternative with the higher initial cost may prove to be more cost-effective. The goal for newly constructed collection systems and rehabilitation of existing collection systems is zero I/I. Additionally, the life cycle cost of treating I/I compared

to the cost of removing I/I completely is a valuable tool. This concept should apply to all wastewater system design projects, especially those that opt for plant expansions to treat excessive I/I rather than remove I/I in the collection system as a number one priority.

The Division will address the problem of inadvertent diversion of surface water when sewer pipelines cross or run close to surface streams (sometimes called "stream capture"). The disturbance of the ground and introduction of porous backfill affects the natural drainage and water quality of streams by providing new underground routes for drainage. When stream crossings are unavoidable, more controls that are stringent will be required in designs. The Division will require alternate routes (or greater offsets from surface streams) for pipelines when crossings are not necessary.

These criteria might not be sufficiently comprehensive to apply to all wastewater treatment and disposal problems in the State. However, the criteria will represent a minimum standard for design of projects for the public welfare and environmental protection. The design engineer should rely upon experience and judgment in supplementing these criteria. Additionally, these criteria may prove too comprehensive (for example, in the treatment of industrial wastes); in either case, the Division staff will consider variances to these criteria provided the engineer can justify the variances requested.

These design criteria use the words "should" and "shall" in various places. The intention is to indicate a difference in the degree of significance of the particular direction or design consideration. The word "shall" indicates a very high degree of concern or significance (compared to the word "should"). Since these criteria are not regulations, then use of the word "shall" does not indicate a legal obligation, unless that obligation is required in a law or regulation.

The Division has delegated authority to some municipal agencies to review plans and specifications for sewer line extensions and sewer rehabilitation projects. Agencies receiving this delegation shall certify that their review is based on the current design criteria used by the Division or standards of the municipality whichever is more stringent.

1.1.2 Types of Projects Affected

The purpose of this chapter is to describe the engineering and procedural steps required by the Division of Water Resources from beginning to completion of a sewerage project. These criteria apply to the development of the following facilities:

- Municipal sewerage systems, subdivisions, trailer parks, apartments, resorts, etc.
- Publicly or privately owned sewerage systems required to obtain a charter (certificate of need and convenience) from the Tennessee Public Service Commission.
- Public corporation sewerage systems organized under the General Corporation Act of Tennessee.
- Public sewerage systems organized under the Federal Housing Authority Title bond.
- All sewerage systems owned by the State of Tennessee.

- Industrial waste systems.
- Industrial sewerage systems.
- Federally owned systems.
- Sewerage systems for schools, service stations, shopping centers, truck stops, or motels.
- Sewerage and industrial waste systems for laundries and car wash facilities.

To be consistent, the Division requires the following procedures for wastewater treatment facilities and proposed discharges to the environment:

a. Upon receipt of a letter requesting planning limits of a proposed discharge, the Division will investigate the proposed point of discharge and may establish appropriate planning limits.

b. Divisional review of the final engineering report and preliminary plans will commence only after the issuance of the effluent planning limits and the site approval.

Detailed information is found in "Wastewater Discharge Checklist", Appendix 1-A.

1.1.3 Requirements

The Division requires the preparation of technical engineering information by an engineer whom has obtained professional licensure to practice within the State of Tennessee, representing the municipality, industry, or owner. The Division requires the submission of this information in two parts:

a. An engineering report and, if the design engineer feels it necessary, preliminary plans. The Division recommends preliminary project discussions, preliminary engineering reports and preliminary plans when there is a very complex project. This will help ensure that the owner, the design engineer and the reviewer are on the same page from the very beginning of the project. This is consistent with the requirements outlined in T.C.A. § 69-3-108 and the rules contained in Chapter 0400-40-02)

b. Final construction plans and specifications.

In addition, a Preliminary Engineering Conference may be necessary on large or complex treatment plant projects. The Division during or prior to the site visit for planning limits will determine this.

Following these steps will reduce the time needed for approval of the project.

1.2 Engineering Report and Preliminary Plans

1.2.1 Goals

The goal of the Division is to promote the simplest treatment scheme available that will meet the requirements of the permit (or draft permit) while providing maximum ease of operation. New wastewater collection systems should be designed to and minimize the potential for infiltration and inflow, to avoid disrupting the flow of natural waters, and to minimize solids deposition in sewers to maintain capacity. While short-term construction cost comparisons are important, long-term operability and reliability should be an overriding influence in developing new sewerage collection and treatment works.

1.2.2 Purpose

Before plans and specifications are prepared for new wastewater facilities, for changes to existing facilities, for new sewer lines, or for sewer rehabilitation work which will decrease the cross-sectional area of an existing sewer by more than 15 percent: every owner or an authorized agent shall submit an engineering report to the Division. The purpose of the engineering report is to outline the goals and objectives of the project and to determine whether the proposed project follows the Division's treatment guidelines and satisfies the applicable minimum requirements set by these guidelines. The report should also serve as a comprehensive guide to the municipality in the decision to adopt a project.

1.2.3 Contents - General

The engineering report shall assemble the basic information, present design criteria and assumptions, evaluate alternative solutions, and offer conclusions and recommendations. The report must be sufficiently complete to facilitate further plans and specifications development. As a minimum, the engineering report for any project shall include the following information where appropriate.

1.2.3.1 Purpose and need for the proposed project.

1.2.3.2 Present and design population with the method of determination

1.2.3.3 Nature and extent of the service area (including immediate and probable future development).

1.2.3.4 Description of the existing collection and/or treatment system, including its condition and problems, renovation and rehabilitation or replacement requirements.

1.2.3.5 Present basis of design including reliable measurements or analysis of flow and wastewater constituents and hydraulic, organic and solids loadings attributed to residential, commercial, and industrial users. (See Chapter 2, Appendix 2-A)

1.2.3.6 The 100-year flood elevation.

1.2.3.7 An evaluation of alternative solutions and the rationale for recommending the chosen alternative, considering economics of operations and effectiveness and all costs over

the life-cycle of the final project. The life-cycle cost considerations should include a calculation of savings and recaptured capacity that may result from sewer rehabilitation upstream of any new sewer interceptors, pump stations, treatment plants and other appurtenances in the submitted project.

1.2.4 Contents – Wastewater Collection Systems

1.2.4.1 Any new sewer alignments or existing sewers replaced in the same trench that cross a stream or are within 50 feet of the bank of the stream will trigger a "site characterization" conducted by the Division to determine the potential for stream capture. The Division uses *Guidance for Making Hydrologic Determinations*, Version 1.4, May 2011, TDEC, as a reference for making a site characterization. A "Stream" means surface water that is not a wet weather conveyance. [Rule 1200-4-3-.04(20)]

If the site characterization indicates there is no potential for stream capture, then the provisions of a general Aquatic Resource Alteration Permit (ARAP) and the criteria in Chapter 2 of these Design Criteria may apply.

If the site characterization determines that there is potential for stream capture, then the Engineering Report shall include a plan to prevent Stream Capture. The Division requires the process to obtain a site-specific ARAP be initiated at the planning stage. The characteristics of streams, hydrology, and subsurface conditions vary widely across the State. Therefore, the design engineer must exercise judgment for selecting appropriate site controls. For difficult site conditions, the Division may require the services of a professional Geologist and an underground (Geotechnical) survey. In some cases, it may be more economical to consider a different route for the sewer.

1.2.4.2 The Division excludes from the requirements of the design criteria sewer rehabilitation work that does not reduce the cross-sectional area of the sewer or that reduces the cross-sectional area of the sewer pipe by less than 15 percent. Submittal of an engineering report or construction plans and specifications is not required. The Division requires the submittal of an engineering report that includes calculations indicating the sewer capacity following rehabilitation relative to both existing and anticipated future flows for sewer rehabilitation projects that result in the decrease of the cross-sectional area of any sewer pipe by 15 percent or more. A reduction in capacity may be offset by work included in the project (or associated projects) to reduce I/I upstream of the rehabilitated pipe.

1.2.5 Contents – Wastewater Treatment Plants

1.2.5.1 Treatment process and schematic flow diagrams giving the plant unit design parameters.

1. 2. 5.2 Solids handling and disposal options and recommendations.

1.2.5.3 Soil and geologic conditions

Sufficient soils and geologic data shall be submitted with the engineering report (or, if the design engineer feels it to be more appropriate depending on the project scope, with the plans)

to evaluate site conditions for all new or major upgrades to treatment plants. At a minimum, the following is required:

a) Soil tests performed - sufficient to provide moisture and compaction data for construction.
b) Borings for representative subsurface conditions. A depth below the bottom footing grade of major structures as recommended by a licensed Tennessee geotechnical engineer.
c) Boring logs or schematic drawings indicating changes of soil types and/or refusal depths.
d) Unsuitable soil conditions with correction or removal contingencies.
e) Karst features with an evaluation of surface water drainage and recommendations as appropriate from a hydrologist/geotechnical engineer licensed in the State of Tennessee.
f) Rock above the bottom footing grade of structures—the Division requires representative core data to a depth recommended by a licensed Tennessee geotechnical engineer. The Division requires an indication of weathered rock conditions along with mud seams or weathered bedding planes.

1.2.5.4 Domestic potable wells within 1000 feet of a plant should be located along with land use of the surrounding area (residential, agricultural, and industrial).

1.2.5.5 The Division requires the submittal of a mass balance for all plants. The mass balances must include loadings to each unit process, operations, including all recycle, and side stream flows. Mass balances must include the following initial and design operating conditions: maximum, minimum, and average flow, BOD and suspended solids loadings; and maximum, minimum, and average nutrient loadings, especially nitrogen for plants with considerable industrial loadings and/or where nutrient removal.

The report should identify and be consistent with all applicable area wide projects, drainage basins, service areas, comprehensive master growth plans, and metropolitan area plans; e.g. 208, and 303(e) plans.

The design period should be for 20 years unless growth of the area dictated other design parameters.

Preliminary plans can be included with the engineering report. The Division will review preliminary plans for adequacy, but not for construction approval.

1.2.6 Submission of Engineering Report and Preliminary Plans

The Division will review and either approve or comment on the engineering report submittal within 30 days.

1.3 Plans and Specifications

1.3.1 General Content of Final Engineering Plans

All plans and specifications must be in accordance with the approved engineering report, unless modifications are justified based on newly discovered data or problems. All plans for sewerage systems or wastewater treatment works should bear a title showing the name of the municipality, sewer district, institution, or other owner and the seal and signature of the design engineer. The title should show the scale in feet, the north direction, and the date. The cover sheet and all other sheets should bear a general title and be logically numbered. Appropriate subtitles should be included on plan sheets.

The plans should be clear, legible, and drawn to a scale that shows clearly all necessary information. The size of the plans should be approximately 24 inches by 36 inches. All plans should include appropriate design data, including, but not limited to initial and design flow. A location map must be included with each set of plans. The cover letter or letter of transmittal should clearly indicate the system and design engineer with addresses.

Detail plans should include plan views, elevations, sections, profiles, and supplementary views. Plans should also specify dimensions and relative elevations of structures, the location and outline form of equipment, location and size of piping, water levels, ground elevations, and erosion control facilities.

1.3.2 Plans of Sewers

The plans should show the location, size, and direction of flow of all proposed and existing sewers draining to the concerned treatment facility. Hydraulic calculations are required for all lines in the project. The Division requires the clear showing of topography and elevations, both existing and any changes proposed, and all bodies of water (including direction of flow and high water elevations). The Division requires hydraulic calculations of pumping stations, taking into consideration existing loading plus projected loading from developments under construction as well as projected loading from the proposed extension.

Profiles for sewer detail should have a horizontal scale of not more than 100 feet to the inch and a vertical scale of not more than 10 feet to the inch. Plan views have a corresponding horizontal scale. All gravity conveyances are at one inch equal to 50 feet horizontal and one inch equal to 10 feet vertical. All pumped (force main) conveyances should be drawn at one inch equal to 100 feet horizontal and one inch equal to 10 feet vertical.

Plans and profiles should show:

1.3.2.1 Locations of streets and sewers.

1.3.2.2. Lines of ground surface, pipe type and size, manhole stationing, invert and surface elevation at each manhole, and grade of sewer between adjacent

manholes. The Division requires manholes labeled on the plan and on the profile correspondingly. Ensure the sewer being sufficiently deep to serve any residence or other source, the elevation and location of the basement floor or other low point source on the profile of the sewer that is to serve the house or source in question.

1.3.2.3 Locations of all special features such as inverted siphons, concrete encasements, elevated sewers, and flow monitoring key manholes.

1.3.2.4 Location of all existing structures below and above ground that might interfere with the proposed construction; particularly water mains, gas mains, storm drains, etc.

1.3.2.5 Detail drawings of all stream crossings with elevations of the streambed and of normal and extreme high and low water levels to the 100-year flood plain, as established by FEMA. See Section 2.4.3.

1.3.2.6 Detail drawings of special sewer joints, cross sections, and appurtenances such as manholes, flush valves, inspection chambers, etc.

1.3.2.7 Location of adjacent streams and the extent of streamside vegetation.

1.3.2.8 An analysis of existing infiltration/inflow should be submitted (and may be required) where I/I is known to be a problem in the existing sewer, and extensions are proposed.

1.3.2.9 General topography including trees within 25 feet of centerline of the proposed sewer main.

1.3.3 Plans of Wastewater Pumping Stations

The Division requires plans be submitted on all wastewater pump stations that serve more than two residences. Any pump station of this size or larger is a "sewerage system" and, as such, must be designed and built in conformance with these criteria. Large stations (serving more than 50 residences) must be owned by a utility or operate under the terms of a State Operation Permit.

1.3.3.1 The Division requires a general layout plan for projects involving construction or substantial modification of pumping stations. The plan should show:

a. The location and extent of the tributary area.

b. A contour map of the property.

c. Any municipal boundaries within the tributary area.

d. The location of the pumping station and force main and pertinent elevations.

e. A site plan showing the forms of land use (commercial, residential, and agricultural) existing or proposed for the near future within a 100-foot radius of the pumping station. Existing buildings and their types within 100 feet of the pumping station property lines should be included.

1.3.3.2 The Division requires detail plans showing:

a. The proposed pumping station, including provisions for installation of future pumps or ejectors.

b. Test boring locations and test boring information, including groundwater elevation, if encountered above the bottom of the proposed excavation for large (≥ 700 GPM) pumping station sites or a site with suspected unusual geological situations present, i.e., karst..

c. Plan and elevation views of the pump suction (from the wet well), and discharge piping showing all isolation valves and gates.

1.3.4 Plans of Wastewater Treatment Plants

1.3.4.1 General

The Division requires a plan to show the wastewater treatment plant in relation to the collection system. Sufficient topographic features should be included to indicate the plant's location in relation to existing buildings within 700 feet of the plant site, streams and the point of discharge of treated effluent.

1.3.4.2 The Division requires a submittal of layouts of the proposed wastewater treatment plant, showing:

a. Topography of the site.

b. Size and location of plant structures.

c. A schematic flow diagram including main and side stream or recycles with unit and pipe sizing through various plant units, in plan view.

d. A summary of design and initial waste loads, unit sizes, and design parameters for each unit process, from the engineering report, noting particularly, any changes in design assumptions.

e. Piping, the materials handled and the direction of flow through the pipes, and any arrangements for bypassing individual units.

f. Minimum, average, and maximum hydraulic profiles showing flow of wastewater, supernatant liquor, and sludge.

g. Test borings and groundwater elevations, if encountered.

h. Ultimate use or disposal of sludge or biosolids.

1.3.4.3 Detail plans must show the following:

a. Location, dimensions, and elevations of all existing and proposed plant facilities.

b. Elevation of high-water level of the receiving body of water, at the 100- year flood, if known, as established by FEMA or some other generally recognized State/Federal agency.

c. Elevation of the low-water level of the receiving body of water.

d. Pertinent data concerning the rated capacity of all pumps, blowers, motors and other mechanical devices—include in the specifications and plans.

1.3.5 Specifications

The objective of the specifications is to supplement the plans by describing the intended project in sufficient detail for competitive bidding and construction.

The specifications should include, but not be limited to, all construction information which is not shown on the drawings and is necessary to inform the builder in detail of the design requirements as to: the quality of materials, workmanship and fabrication of the project, and the type, size, operating characteristics, and rating of equipment; allowable leakage; machinery; valves, piping, and jointing of pipe; electrical apparatus, wiring, and meters; laboratory fixtures and equipment; operating tools; construction materials; special materials such as stone, sand, gravel or slag; miscellaneous appurtenances; instructions for testing materials and equipment as necessary to meet design standards; and operating tests for the completed works and component units.

The specifications and/or plans should contain sufficient information to allow clear access to siphon structures with barrel isolation gates for cleaning.

A fence should surround all wastewater treatment plants. The Division requires a fence of fabric that is at least six feet high and of a type that is difficult to climb and topped with at least two strands of barbed wire. The exceptions to this type of fencing are lagoons and land application systems. Such treatment plants can use livestock fence, if a sufficient number of signs are attached which contain a warning against trespassing and indicate that the fenced area is used for treating wastewater. Generally, pumping stations should be fenced similarly to plants with the exception that the entrance tube to "canned" lift stations need not be fenced.

1.3.6 Review and Approval Procedure

Every owner or his authorized representative, before installing wastewater or industrial waste facilities, or for changes (rehabilitation, relocation or repair) in the existing system, should submit four sets of complete plans and specifications of the proposed facilities to the Division. Construction cannot start without approval from the Division.

If the owner of the project is not the ultimate recipient of the wastewater, the recipient must approve the plans and specifications and must agree to receive wastes and provide treatment, before construction begins.

All plans and specifications shall be prepared under the supervision of a professional engineer. All copies of plans and specifications submitted for review shall bear the seal and signature of the professional engineer, licensed to practice in the State of Tennessee, who supervised their preparation. Each sheet of the plans shall be hand dated with a copy of the seal and signature of the engineer. The original seal, signature and date are required only on the title sheet and front cover of the specifications.

The Division will review and either approve or comment on the final plans and specifications within 30 days. The Division will retain one copy of plans and specifications for the record, with the remaining returned to the owner.

The Division requires that one stamped copy of the approved plans and specifications be on the construction site and ready to show to the state inspector. Colorized photocopies or scanned plans approved by the Division are acceptable to be on site as an alternative but must be 24 inches by 36 inches in size. Failure to do so may result in a shutdown of construction until an approved copy of the plans is available on site.

1.3.7 Revisions to Approved Plans

Prior to any changes, the Division must approve any deviations from approved plans or specifications affecting capacity, flow, operation of units, or point of discharge in writing.

The Division will permit minor structural revisions during construction with the concurrence of the design engineer.

1.3.8. Construction Supervision

The owners should ensure that competent and experienced personnel, preferably the design engineer or his representative, carefully monitor the progress of construction to see that all work conforms to the approved plans and specifications.

Any modifications to the plans or specifications during construction must have approval by the Division (Section 1.3.7).

1.3.9 Operation During Construction

The Division requires all construction to be in accordance with applicable permit requirements.

1.3.10 Final Review of Treatment Facilities

The Division must receive a written request for final review approval of the treatment facilities at least two weeks in advance of the requested date.

In cases of plant upgrades or modifications, the Division may allow individual units to operate prior to final review in order to facilitate construction. The Division requires prior approval to do this (see Section 1.3.9).

1.3.11 Reliability Classification

1.3.11.1 General

Reliability standards establish minimum levels of reliability for three classes of sewerage works (see Section 1.1.2). Pump stations associated with, but physically removed from, the actual treatment works may have a different classification than the treatment works itself. Specific requirements pertaining to treatment plant unit processes for each reliability class are described in EPA's technical bulletin, Design Criteria for Mechanical, Electric, and Fluid System and Component Reliability, EPA 430-99-74-001; available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

The Division of Water Resources will assign the reliability classification during the planning limits/site approval phase of the project.

1.3.11.2 Guidelines for classifying sewerage works as follows:

a. Reliability Class I

Examples of Reliability Class I works might be those discharging near drinking water reservoirs, into shellfish waters, or in close proximity to areas used for water contact sports.

b. Reliability Class II

Works which discharge into navigable waters that would not be permanently or unacceptably damaged by short-term effluent quality degradations, but could be damaged by continued (approximately several days) effluent quality degradation. An example of a Reliability Class II works might be one that discharges into recreational waters.

c. Reliability Class III

These are works not otherwise classified as Reliability Class I or Class II.

1.3.11.3 Component Backup Requirements

Below are requirements for Reliability Class I, II, and III works (backup components for the main wastewater treatment system).

The Division will not consider equalization basins or tanks as a substitute for component backup requirements.

a. Reliability Class I

For components included in the design of Reliability Class I works, the following backup requirements apply.

<u>Mechanically-Cleaned Bar Screens or Equivalent Devices</u>

A backup bar screen should be provided. It is permissible for the backup bar screen to be designed for manual cleaning only. Works with only two bar screens should have at least one bar screen designed to permit manual cleaning.

<u>Pumps</u>

For each set of pumps that perform the same function a backup pump is required. The capacity of the pumps should be such that, with any one pump out of service, the remaining pumps will have the capacity

to handle the peak flow. It is permissible for one pump to serve as backup to more than one set of pumps.

Comminution Facility

An overflow bypass with an installed manually- or mechanically-cleaned bar screen is required if comminution of the total wastewater flow is provided. The hydraulic capacity of the comminutor overflow bypass should be sufficient to pass the peak flow with all comminution units out of service.

Primary Sedimentation Basins

There should be a sufficient number of units of a size such that, with the largest flow capacity unit out of service, the remaining units should have a design flow capacity of at least 50 percent of the total design flow to that unit operation.

Final and Chemical Sedimentation Basins, Trickling Filters, Filters and Activated Carbon Columns

There should be a sufficient number of units of a size such that, with the largest flow capacity unit out of service, the remaining units should have a design flow capacity of at least 75 percent of the total design flow to that unit operation.

Activated Sludge Process Components

Aeration Basin

At least two equal volume basins are required. (For the purpose of this criterion, the two zones of contact stabilization process equal only one basin.)

Aeration Blowers or Mechanical Aerators

A sufficient number of blowers or mechanical aerators are required to enable the design oxygen transfer with the largest capacity unit out of service. At least two units are required.

Air Diffusers

The requirement for the air diffusion system for each aeration basin is such that the largest section of diffusers can be

isolated without measurably impairing the oxygen transfer capability of the system.

Disinfectant Contact Basins

There should be a sufficient number of units of a size such that, with the largest flow capacity unit out of service, the remaining units should have a design flow capacity of at least 50 percent of the total design flow to that unit operation.

b. Reliability Class II

The Reliability Class I requirements shall apply except as modified below.

Primary and Final Sedimentation Basins and Trickling Filters

There should be a sufficient number of units of a size such that, with the largest flow capacity unit out of service, the remaining units should have a design flow capacity of at least 50 percent of the design basis flow to that unit operation.

Components Not Requiring Backup

Requirements for backup components in the wastewater treatment system shall not be mandatory for components which are used to provide treatment in excess of typical biological (i.e., activated sludge or trickling filter), or equivalent physical/chemical treatment, and disinfection. This may include such components as:

Chemical Flash Mixer

Flocculation Basin

Chemical Sedimentation Basin

Filter

Activated Carbon Column

c. Reliability Class III

The Reliability Class I requirements should apply except as modified below.

Primary and Final Sedimentation Basins

There should be at least two sedimentation basins.

Activated Sludge Process Components

Aeration Basin

A single basin is permissible.

Aeration Blowers or Mechanical Aerators

There should be at least two blowers or mechanical aerators available for service.

Air Diffusers

The Reliability Class I requirements shall apply.

Components Not Requiring Backup

Requirements for backup components in the wastewater treatment system are not mandatory for components to provide treatment in excess of primary sedimentation, and disinfection, except as modified above. This may include such components as:

Trickling Filter

Chemical Flash Mixer

Flocculation Basin

Chemical Sedimentation Basin

Filter

Activated Carbon Column

1.3.11.4 Component Design Features and Maintenance Requirements

Provisions for Isolating Components

Each component should have provisions to enable it to be isolated from the flow stream to permit maintenance and repair of the component without interruption of the works' operation.

Main Wastewater System Pump Isolation

Minimize the use of in-line valves to isolate the main wastewater pumps. It is permissible to place shutoff valves on the suction and discharge lines of each pump. However, in such a case, provide an alternate means for stopping flow through the pump suction or discharge lines to permit maintenance on the valve.

1.3.11.5 Electric Power System

The following criteria should apply to those portions of the system supplying power to vital components. A vital component is one whose operation or function is required to prevent a controlled diversion, is required to meet effluent parameters, or is required to protect other vital components from damage. Identify vital components in the permit/site approval phase, depending on the reliability class and treatment scheme employed. Find further information in Chapter 14, Instrumentation, Control and Electrical Systems.

Power Sources

Provide two separate and independent sources of electric power to the works either from two separate utility substations or from a single substation and a works (plant and/or main pump station) generator. If available from the electric utility, at least one of the works' power sources should be a preferred source (i.e., a utility source that is one of the last to lose power from the utility grid due to loss of power generating capacity). As a minimum, the capacity of the backup power source for each class of treatment works should be:

Reliability Class I

Sufficient to operate all vital components, during peak wastewater flow conditions, together with critical lighting and ventilation.

Reliability Class II

Same as Reliability Class I, except that vital components used to support the secondary processes (i.e., mechanical aerators or aeration basin air compressors) need not be included as long as the treatment provided is equivalent to sedimentation and disinfection.

Reliability
Class III

Sufficient to operate the screening or communication facilities, the main wastewater pumps, the primary sedimentation basins, and the disinfection facility during peak wastewater flow condition, together with critical lighting and ventilation.

Power Distribution External to the Works

Distribute the independent sources of power to the works' transformers in a way to minimize common mode failures from affecting both sources.

Example: The two sets of distribution lines should not be located in the same conduit or supported from the same utility pole. The two sets of overhead distribution lines, if used, should not cross or be located in an area where a single plausible occurrence (e.g., fallen tree) could disrupt both lines. Use devices to protect the system from lightning.

Transformers

Transform each utility source of power to the works to usable voltage with a separate transformer. Protect the transformers from common mode failure by physical separation or other means.

Power Distribution Within the Works

Service to Motor Control Centers

The internal power distribution system should be designed such that no single fault or loss of a power source will result in disruption (i.e., extended, not momentary) of electric service to more than one motor control center associated with the Reliability Class I, II, or III vital components requiring backup power.

Division of Loads at Motor Control Centers

Divide vital components of the same type and serving the same function as equally as possible between at least two motor control centers. Also, divide nonvital components in a similar manner, where practicable.

Power Transfer

Where power feeder or branch circuits can be transferred from one power source to another, a mechanical or electrical safety device should be provided to assure that the two power sources cannot be cross-connected, if unsynchronized. Provide automatic transfer in those cases when the time delay required to manually transfer power could result in a failure to meet effluent limitations, a failure to process peak influent flow, or cause damage to equipment. Also, where automatic pump control is used, similarly transfer the control panel power source and pump power source.

Example: The connection of the two power sources from utility substations to the motor control centers through circuit breakers. Provide a circuit breaker to cross-connect the two motor control centers in the event one of the two normally energized power feeders fails. Achievement of additional backup capability for the main pump by connecting one of the three pumps to the motor control center cross-connect. This assures that two out of three pumps will be available in the event of a panel fire or panel bus short circuit.

Breaker Settings or Fuse Ratings

Breaker settings or fuse ratings should be coordinated to effect sequential tripping such that the breaker or fuse nearest the fault will clear the fault prior to activation of other breakers or fuses to the degree practicable.

Equipment Type and Location

Try to minimize failures resulting from plausible causes, such as fire or flooding through better equipment design and location. The following requirements apply:

Switchgear Location

Protect electric switchgear and motor control centers from sprays or moisture from liquid processing equipment and from breaks in liquid handling piping. Locate, where practicable, the electric equipment in a separate room from the liquid processing equipment. Do not run liquid handling piping through this room. Locate the electric switchgear and motor control centers above ground and at a minimum, two feet above the one hundred year flood (or wave action) elevation.

Conductor Insulation

Wires in underground conduits or in conduits that can be flooded should have moisture resistant insulation as identified in the National Electric Code.

Motor Protection from Moisture

Protect all outdoor motors adequately from the weather. Motors located indoors and near liquid handling, piping or equipment should be, at least, of splash-proof design. Consider providing heaters in motors located outdoors or in areas where condensation may occur.

The following criteria should apply to motors (and their local controls) associated with vital components. All outdoor motors, all large indoor motors (i.e., those not readily available as stock items from motor suppliers), and, where practicable, all other indoor motors, should be located at a minimum of two feet above the one hundred year flood (or wave action) elevation or from clogged floor drains. Indoor motors located at or below the one hundred year flood (or wave action) elevation should be housed in a room or building which is protected from flooding during the one hundred year flood (or wave action). The building protection should include measures such as no openings (e.g., submarine doors, windows, hatches) to the outside below the flood elevation and a drain sump pumped to an elevation above the flood elevation.

Explosion Proof Equipment

Use explosion proof motors, conduit systems, switches and other electrical equipment in areas where flammable liquid, gas or dust is likely to be present.

Routing of Cabling

To avoid a common mode failure, do not route conductors to components that perform the same function in parallel in the same conduit or cable tray. Conduits housing such cables should not be routed in the same underground conduit bank unless the conduits are protected from common mode failures (such as by encasing the conduit bank in a protective layer of concrete).

Motor Protection

Protect three-phase motors and their starters from electric overload and short circuits on all three phases.

Large motors should have a low-voltage protection device that, on the reduction or failure of voltage, will cause and maintain the interruption of power to that motor.

Consider the installation of temperature detectors in the stator and bearings of large motors in order to give an indication of overheating problems.

Provisions of Equipment Testing

Include provisions in the design of equipment requiring periodic testing, to accomplish the tests while maintaining electric power to all vital components. This requires being able to conduct tests, such as actuating and resetting automatic transfer switches, and starting and loading emergency generating equipment.

Maintainability

Design the electric distribution system and equipment to permit inspection and maintenance of individual items without causing a controlled diversion or causing violation of the effluent limitations.

Emergency Power Generator Starting

The means for starting a works-based emergency power generator should be completely independent of the normal electric power source. Air starting systems should have an accumulator tank(s) with a volume sufficient to furnish air for starting the generator engine a minimum of three (3) times without recharging. Batteries used for starting should have a sufficient charge to permit starting the generator engine a minimum of three (3) times without recharging. The starting system should be appropriately alarmed and instrumented to indicate loss of readiness (e.g., loss of charge on batteries, loss of pressure in air accumulators, etc.).

1.3.12 New Technology

The definition of new technology is any method, process, or equipment used to treat or convey wastewater and not discussed in this manual. This does not refer to innovative technology as defined by EPA.

After review of treatability data and the complete engineering report, the Division may approve the plans if it is satisfied that the method, process or equipment will efficiently operate and meet the treatment requirements.

Appendix 1-A

Wastewater Discharge Checklist

1. Applicant contacts appropriate Environmental Field Office and Nashville Central Office, to discuss project submittals.

2. On all proposed discharges in the smaller flow ranges, the applicant must first investigate subsurface disposal (even at a remote site) and transference to a public sewer system.

3. Applicant submits required information and requests site inspection/planning limits. Field Office responds to applicant on results, including the assigned reliability classification.

4. Applicant submits NPDES application with associated information; i.e., owner/operator, financial information and preliminary engineering report to the Field Office.

5. Permit Section forwards draft permit to Field Office and applicant and issues public notice of intent to (not to) issue NPDES permit.

6. Permit Section evaluates responses to draft permit and public notice, makes decision on necessity for public hearing, issues public notice of hearing, if required, conducts public hearing, evaluates comments, makes and publicizes issuance decision.

7. Final engineering report submitted, reviewed and approved.

8. Final plans and specifications submitted, reviewed and approved for construction.

9. Construction proceeds and applicant requests final inspection by the Field Office.

Appendix 1-B

Guiding Principles, Goals, and Implementation Methods

Tennessee Collection Systems

Guiding Principles, Goals, and Implementation Methods

The Mission of the Department of Environment and Conservation (TDEC) is to enhance the quality of life for citizens of Tennessee and to be stewards of our natural environment by protecting and promoting human health and safety, and protecting and improving the quality of Tennessee's water through a responsible regulatory system.

In keeping with TDEC's mission, the purpose of this document is for the Division of Water Resources (DWR) to set guiding principles for the development and implementation of collection system policy for the State of Tennessee. Any policy, guidance and/or criteria established for the state must be consistent with these principles.

The Division staff has observed many instances in municipalities across the state where leakage of water into sewage collection systems (I/I – infiltration and inflow) has been a direct or indirect cause of permit violations and pollution of the environment. Additionally, I/I steals part of the capacity of sewage collection and treatment systems. In some cases, this loss of capacity has hindered growth and caused economic problems in those communities. I/I in sewage collection systems increases the cost of conveyance and treatment and this is reflected in higher bills paid by the customers.

The overarching goal is to ensure that Tennessee's wastewater infrastructure (primarily collection systems) is sustainable, energy efficient and protective of public health and water resources. Modern, proven technologies and materials are commonly available to stop or prevent leakage into sewage collection systems. Therefore, a major focus of this policy is to reduce I/I in Tennessee communities. This requires a two-pronged approach: 1) promote design and construction practices that do not allow leakage into new sewage collection systems, and 2) promote rehabilitation processes, practices and strategies that eliminate I/I in existing sewage collection systems. The following principles, goals and, implementation methods are focused on this two-pronged approach.

GUIDING PRINCIPLES

- Collection system policy, criteria and guidance should be developed in a transparent manner by TDEC with significant involvement of the key stakeholders (regulated and design communities).
- Collection system design criteria should promote new sewer design that minimizes the potential for infiltration and inflow. Examples would include methods that prevent trench water accumulation and stream capture or new technologies such as HDPE heat fused pipe. Additionally, the design criteria should include practices minimize solids deposition within sewers.
- Collection System operations and maintenance practices should optimize capacity utilization.
- The legal/enforcement framework for collection system policy should acknowledge that more time is often needed to build a more sustainable infrastructure than by

simply increasing capacity in terms of pipe size, pumping and treatment. The legal framework should also evaluate ways to address easement and ownership of private laterals and taps.

GOALS

- Tennessee's collection system policy should provide support for TDEC in setting requirements for system design, correction, operation and management.
- Tennessee's collection system policy should provide support for decision makers, tools for improved management (utility manager, boards, mayors & other elected officials), including improved request for proposal procedures.
- Tennessee's collection system policy should provide for better assurance of proper construction and promote slowing down the degradation of infrastructure.

IMPLEMENTATION METHODS

- Review and revise current design criteria for new construction and rehabilitation and establish set schedule for review.
- Train and educate utilities, consultants, contractors, and other stakeholders on successful sewer rehabilitation approaches.
- Establish procedures by which TDEC resources move towards construction inspection as opposed to plans review.
- Provide a collection system construction inspection class as well as other courses targeted for utility personnel training.
- Require that life cycle analysis (including the cost of I/I over the life of the project) is part of design criteria and required for engineering report/plans submittal.
- Require stricter adherence to design criteria and consistency with Tennessee Collection System Policy.

Sandra K. Dudley, Ph.D., P.E.
Director, Division of Water Resources

12/14/12
Date